

indicated by the appended claims rather than by the foregoing description. All changes which come within the meaning and range of equivalency of the claims are to be embraced within their scope.

5           What is claimed and desired to be secured by United States Letters Patent is:

1. A method of subjecting at least a first biological sample to rapid thermal cycling, the method comprising the steps of:

5 (a) placing the first biological sample in at least a first container;

(b) raising the temperature of the first biological sample from a first temperature to a second temperature at a first rate at least as great as 1°C per second, the first temperature being at least 20°C different than the  
10 second temperature;

(c) holding the first biological sample at a temperature at least as great as the second temperature for not more than a first holding period, the first holding period being not greater than ten seconds;

15 (d) lowering the temperature of the first biological sample from the second temperature to at least the first temperature at a second rate at least as great as 1°C per second;

(e) holding the first biological sample at a  
20 temperature at least as low as the first temperature for

not more than a second holding period, the second holding period being not greater than ten seconds; and

(f) removing the first biological sample from the first container.

5           2.    A method of subjecting at least a first biological sample to rapid thermal cycling as defined in claim 1 wherein the first temperature is at least 30°C different than the second temperature.

10           3.    A method of subjecting at least a first biological sample to rapid thermal cycling as defined in claim 1 wherein the first temperature is at least 40°C different than the second temperature.

15           4.    A method of subjecting at least a first biological sample to rapid thermal cycling as defined in claim 1 wherein the first rate is at least as great as 4°C per second.

            5.    A method of subjecting at least a first biological sample to rapid thermal cycling as defined in claim 4 wherein the second rate is at least as great as 4°C per second.

6. A method of subjecting at least a first biological sample to rapid thermal cycling as defined in claim 1 wherein the first rate is at least as great as 10°C per second.

7. A method of subjecting at least a first biological sample to rapid thermal cycling as defined in claim 6 wherein the second rate is at least as great as 10°C per second.

8. A method of subjecting at least a first biological sample to rapid thermal cycling as defined in claim 1 wherein the first holding period is not greater than 3 seconds.

9. A method of subjecting at least a first biological sample to rapid thermal cycling as defined in claim 8 wherein the second holding period is not greater than 3 seconds.

10. A method of subjecting at least a first biological sample to rapid thermal cycling as defined in claim 1 wherein the first holding period is not greater than 1 second.

11. A method of subjecting at least a first biological sample to rapid thermal cycling as defined in claim 10 wherein the second holding period is not greater than 1 second.

12. A method of subjecting at least a first biological sample to rapid thermal cycling as defined in claim 1 wherein

the step of placing the first biological sample in at least a first container comprises the steps of:

placing a first portion of the biological sample into the first container;

5 placing a second portion of the biological sample into a second container;

placing a third portion of the biological sample into a third container; and

10 placing a fourth portion of the biological sample into a fourth container.

13. A method of subjecting at least a first biological sample to rapid thermal cycling as defined in claim 12 further comprising the step of positioning the first, second, third, and fourth containers in a sample chamber and wherein the step  
15 of raising the temperature of the first biological sample comprises the step of subjecting the first, second, third, and fourth containers to infrared radiation.

14. A method of subjecting at least a first biological sample to rapid thermal cycling as defined in claim 1 further  
20 comprising the step of repeating steps (b) through (e) at least fifteen times.

15. A method of subjecting at least a first biological sample to rapid thermal cycling as defined in claim 1 further comprising the step of repeating steps (b) through (e) at least thirty times in not more than 10 minutes.

5        16. A method of subjecting at least a first biological sample to rapid thermal cycling as defined in claim 1 wherein the step of placing the first biological sample in at least a first container comprises the step of placing the first biological sample in at least the first container having a  
10 volume in the range from about 1  $\mu$ l to about 10,000  $\mu$ l.

17. A method of subjecting at least a first biological sample to rapid thermal cycling as defined in claim 16 wherein the step of placing the first biological sample in at least a first container further comprises the step of placing the  
15 first biological sample in at least the first container having an inner diameter in the range from about 0.02mm to about 1.0mm.

18. A method of subjecting at least a first biological sample to rapid thermal cycling as defined in claim 1 wherein  
20 the step of raising the temperature of the first biological sample comprises the step of adjusting the first rate.

19. A method of subjecting at least a first biological sample to rapid thermal cycling as defined in claim 1 wherein the step of lowering the temperature of the first biological sample comprises the step of adjusting the second rate.

5        20. A method of subjecting at least a first biological sample to rapid thermal cycling as defined in claim 1 wherein the step of holding the biological sample at a temperature comprises the step of adjusting the length of the first holding period.

10        21. A method of subjecting at least a first biological sample to rapid thermal cycling as defined in claim 1 wherein the step of lowering the temperature of the first biological sample comprises the step of moving ambient air past the first container at a rate at least as great as 500 meters per  
15 minute.

22. A method of subjecting at least a first biological sample to rapid thermal cycling as defined in claim 1 wherein the first biological sample comprises DNA and primers.

23. A method of subjecting at least a first biological sample to rapid thermal cycling, the method comprising the steps of:

5 (a) placing the first biological sample in at least a first container, the first container having a volume in the range from about 1  $\mu\text{l}$  to about 10,000  $\mu\text{l}$ ;

(b) raising the temperature of the first biological sample from a first temperature to a second temperature at a first rate at least as great as 10°C per second, the  
10 first temperature being at least 30°C different than the second temperature, the temperature of the first biological sample being homogeneously raised such that no portion of the first biological sample is more than about 5°C warmer or cooler than any other portion of the first  
15 biological sample;

(c) holding the first biological sample at a temperature at least as great as the second temperature for not more than a first holding period, the first holding period being not greater than three seconds;

20 (d) lowering the temperature of the first biological sample from the second temperature to at least



the first temperature at a second rate at least as great as 10°C per second;

(e) holding the first biological sample at a temperature at least as low as the first temperature for not more than a second holding period, the second holding period being not greater than three seconds;

(f) removing the first biological sample from the first container; and

(g) repeating steps (b) through (e) at least fifteen times.

24. A method of subjecting at least a first biological sample to rapid thermal cycling as defined in claim 23 further comprising the step of repeating steps (b) through (e) a plurality of times and wherein the step of raising the temperature of the first biological sample comprises the step of holding the temperature of the first biological sample at a third temperature for not more than 10 seconds, the third temperature being intermediate the first temperature and the second temperature.

20

25. A method of subjecting at least a first biological sample to rapid thermal cycling as defined in claim 23 wherein the step of placing the first biological sample in at least a first container comprises the steps of:

5           placing a first portion of the biological sample into the first container;

          placing a second portion of the biological sample into a second container;

          placing a third portion of the biological sample  
10       into a third container; and

          placing a fourth portion of the biological sample into a fourth container;

and wherein the method further comprises the step of positioning the first, second, third, and fourth containers in  
15   a sample chamber and wherein the step of raising the temperature of the first biological sample comprises the step of subjecting the first, second, third, and fourth containers to infrared radiation.

26. A method of subjecting at least a first biological  
20   sample to rapid thermal cycling' as defined in claim 23 wherein

the step of raising the temperature of the first biological sample comprises the step of adjusting the first rate.

27. A method of subjecting at least a first biological sample to rapid thermal cycling as defined in claim 23 wherein  
5 the step of lowering the temperature of the first biological sample comprises the step of moving ambient air past the first container at a rate at least as great as 500 meters per minute.

28. A method of subjecting at least a first biological  
10 sample to rapid thermal cycling as defined in claim 23 wherein the first biological sample comprises DNA and primers.

29. A method of subjecting at least a first biological sample containing a DNA template, an oligonucleotide primer, and a reaction buffer to perform cyclic DNA amplification  
15 using a thermostable DNA polymerase, the method comprising the steps of:

(a) placing the first biological sample in a plurality of containers, each container having a volume in the range from about 1  $\mu$ l to about 10,000  $\mu$ l;

20 (b) raising the temperature of the first biological sample placed in each of the plurality of containers from

a first temperature to a second temperature at a first rate at least as great as 10°C per second, each of the plurality of containers being subjected to infrared radiation, the first temperature being at least 30°C different than the second temperature, the temperature of the first biological sample being homogeneously raising such that no portion of the first biological sample is more than about 5°C warmer or cooler than any other portion of the first biological sample found in the same or any of the other of the plurality of containers;

(c) holding the first biological sample at a temperature at least as great as the second temperature for not more than a first holding period, the first holding period being not greater than one second;

(d) lowering the temperature of the first biological sample from the second temperature to at least the first temperature at a second rate at least as great as 10°C per second by moving air past the first container at a rate at least as great as 250 meters per minute;

(e) holding the first biological sample at a temperature at least as low as the first temperature for

not more than a second holding period, the second holding period being not greater than one second;

(f) removing the first biological sample from substantially all of the plurality of containers; and

5 (g) repeating steps (b) through (e) at least fifteen times.